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A KRYPTON-83m GENERATOR

A. A. Moghissi, et al

Southwestern Radiological Health Laboratory
Las Vegas, Nevada

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KRYPTON-83*m* has several useful applications.[1,2] It can be used to follow the separation of ^{85}Kr from air for surveillance purposes and it is potentially attractive for studies of pulmonary function.

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Preparation of ^{83}Rb

Rubidium-83 was produced by ^{83}Kr(p,n)^{83}

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With a half life of approximately 2 hr ^{83m}Kr is ideally suited for other laboratory experiments involving gases. The only obstacle in the application of ^{83m}Kr seems to be the difficulties involved with its availability.

Although several methods for the production of ^{83m}Kr have been proposed,[1,2] no generator for laboratory use has been reported. A convenient method of producing such a generator seems to be by means of ^{83}Rb which decays with an abundance of 77 per cent to ^{83m}Kr.

The production of pure ^{83}Rb is difficult and expensive. For the purpose of ^{83m}Kr production, the purity of ^{83}Rb is, however, irrelevant and the presence of ^{84}Rb commonly accompanying ^{83}Rb poses no problem. With a half life of 83 days ^{83}Rb is well suited for laboratory use. Following is the description of a ^{83}Rb–^{83m}Kr generator:

Preparation of ^{83}Rb

Rubidium-83 was produced by ^{83}Kr(p,n)^{83}Rb reaction in the external proton beam of the ORNL 86-in. cyclotron. A thin aluminum cylinder containing 750 ml of naturally occurring krypton gas was bombarded for one hour at a beam current of

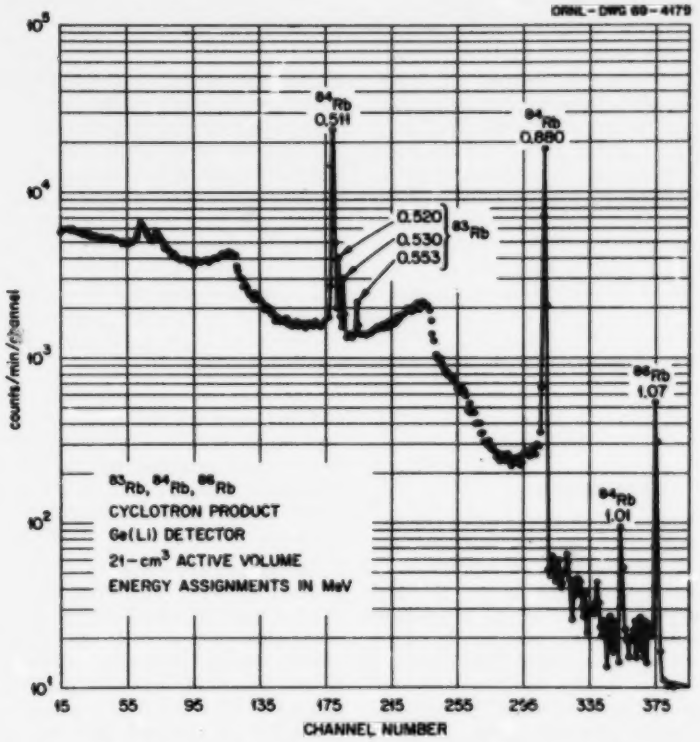

FIG. 1. Gamma-ray spectrum of the rubidium product.

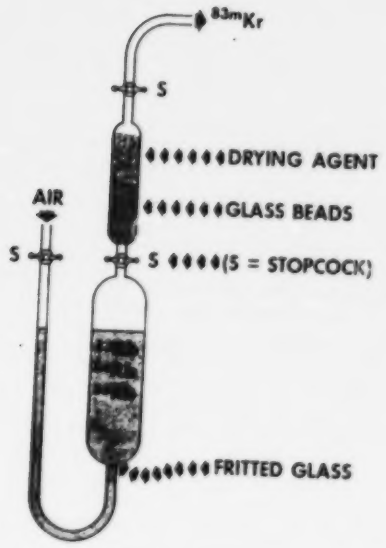

FIG. 2. ^{83m}Kr generator.

27 μA producing approximately 0·18 mCi of ^{83}Rb. After the bombardment, the krypton gas was pumped from the cyliuder, and the rubidium was washed from the cylinder walls with warm water. The solution was evaporated to dryness and reconstituted in dilute hydrochloric acid. Concurrent production of ^{84}Rb (half life = 33d) and ^{86}Rb (half life = 18·7d) from ^{84}Kr(p,n)^{84}Rb and ^{86}Kr(p,n)^{86}Rb reactions, respectively, presents no problem since neither of the radionuclides decays to a radionuclide of krypton. The composition of the rubidium chloride solution used in this study was 58·1% ^{84}Rb, 31·7% ^{86}Rb, and 10·2% ^{83}Rb at the termination of bombardment. A gamma-ray spectrum of the product taken using a 21 cm^3 Ge(Li) detector coupled with a multichannel analyzer is shown in Fig. 1.

^{83m}Kr Generator

It has long been established that noble gases are to some extent soluble in water and that they can be easily displaced by purging the solution with other gases. Radon bubblers are extensively used in the radium laboratories for analysis of radium. The same concept is used in this work for the separation of ^{83m}Kr from a ^{83}Rb solution. The details of the bubbler are shown in Fig. 2. The container is filled with approximately 10 ml of ^{83}Rb–^{84}Rb–^{86}Rb solution, including rubidium carrier (approx. 0·01 molar). Air is passed through the fritted glass, through the solution containing ^{83m}Kr. Any liquid which may be carried with the air is removed at the top of the column by glass beads and a drying agent. At the end of the separation the stopcocks are closed to avoid the release of ^{83m}Kr and the absorption of moisture by the drying agent.

The generator was evaluated in a scintillation counting system described by MOGHISSI *et al.*[3] except that a scaler was added to integrate the total counts and a smaller detector was used. This detector consisted of two parallel plates of plastic phosphor separated by 2 mm of a Lucite ring as shown in Fig. 3.

Inasmuch as the absolute activity of ^{83}Rb and the counting efficiency of the detector were only approximately known, no attempt was made to determine quantitatively the recovery of ^{83m}Kr. From radon experiments it was known that approximately 100 ml of nitrogen removes the radon quantitatively from a known radium solution.

Approximately 1 μCi of ^{83}Rb–^{84}Rb containing circa 30% ^{83}Rb was purged every 112 min to determine the reproducibility of the system. It was found that more than 99 per cent of the detectable gaseous activity was removed in the first 120 ml of air passed through the solution with a reproducibility of better than 2 per cent. Thus, it can reasonably be assumed that the recovery of ^{83m}Kr is quantitative.

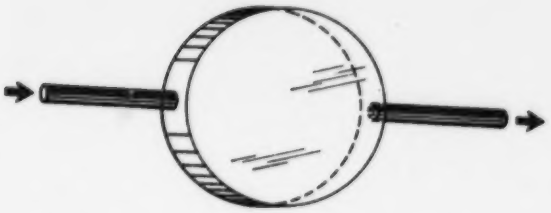

FIG. 3. Detector head made of plastic scintillator.

The bubbler was made of glass. A simplified polyethylene bubbler is under construction.

A. A. MOGHISSI
Southwestern Radiological Health Laboratory
P.O. Box 15027
Las Vegas, Nevada 89114
U.S.A.

*Oak Ridge National Laboratory** H. B. HUPF
Isotopes Development Center
P.O. Box X
Oak Ridge, Tenn. 37830
U.S.A.

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